

Amendments to the Claims

This listing of claims will replace all prior versions and listings of claims in the application:

1-54. (Canceled)

55. (New) A spray nozzle comprising:

a swirl disk formed of a sheet material substrate defining a thickness within the range of about 0.003 inch to about 0.03 inch, an etched peripheral edge, an etched first region spaced inwardly relative to the etched peripheral edge and forming a first aperture extending through the first region and defining a swirl chamber, and an etched second region extending between the swirl chamber and peripheral edge and defining a second aperture extending through the second region forming a flow inlet to the swirl chamber;

an orifice disk formed of a sheet material substrate defining a thickness within the range of about 0.005 inch to about 0.03 inch, an etched peripheral portion defining a peripheral edge, and an etched first region spaced inwardly relative to the peripheral edge and defining a first aperture extending through the first region and forming a spray orifice;

a retaining body defining an inlet aperture and an outlet aperture; and

a retaining member receivable within the retaining body;

wherein at least one fluid passageway is formed between the inlet aperture of the retaining body and the flow inlet to the swirl chamber; the orifice disk is positioned within the retaining body with the spray orifice aligned with and adjacent to the outlet aperture of the retaining body; the swirl disk is positioned within the retaining body upstream of and contiguous to the orifice disk with the swirl chamber aligned and in fluid communication with the spray orifice of the orifice disk; and the retaining member is positioned within the retaining body in engagement with an opposite side of the swirl disk relative to the orifice disk to secure the retaining member, the orifice disk and swirl disk within the retaining body.

56. (New) A spray nozzle as defined in claim 55, wherein the swirl disk further defines a first substantially planar surface on one side of the swirl disk, and a second substantially planar surface on an opposite side of the swirl disk.

57. (New) A spray nozzle as defined in claim 56, wherein the first and second surfaces are substantially symmetrical about a plane approximately perpendicular to an axis of the swirl disk.

58. (New) A spray nozzle as defined in claim 57, wherein the first and second surfaces of the swirl disk are substantially identical.

59. (New) A spray nozzle as defined in claim 56, wherein at least one of the surfaces of the swirl disk includes a wear-resistant coating.

60. (New) A spray nozzle as defined in claim 56, wherein at least one of the surfaces of the orifice disk includes a wear-resistant coating.

61. (New) A spray nozzle as defined in claim 55, wherein the swirl disk defines a throat formed between the swirl inlet and swirl chamber, the swirl chamber defines a start radius, and the ratio of the throat divided by the start radius is within the range of about 0.6 through about 1.1.

62. (New) A spray nozzle as defined in claim 55, wherein the swirl disk defines a thickness within the range of about 0.005 inch through about 0.015 inch.

63. (New) A spray nozzle as defined in claim 55, wherein the orifice disk defines a thickness within the range of about 0.015 inch through about 0.025 inch.

64. (New) A spray nozzle as defined in claim 55, wherein the ratio of the axial depth of the spray orifice (L) to a diameter of the spray orifice (D) is within the range of about 0.16 through about 6.

65. (New) A spray nozzle as defined in claim 55, wherein the retaining member defines at least one flat, and the flat defines a fluid flow path between the retaining member and retaining body and extending between the inlet of the retaining body and an annulus formed between the plug and retaining body for fluid flow therebetween.

66. (New) A spray nozzle as defined in claim 55, further comprising a filter adjacent to the retaining member for preventing contaminants from entering the spray nozzle.

67. (New) A spray nozzle as defined in claim 55, wherein the swirl disk further defines a plurality of swirl chambers and a plurality of corresponding swirl inlets, and each swirl inlet extends between a respective swirl chamber and the peripheral edge of the swirl disk.

68. (New) A swirl disk defining a flow inlet and a swirl chamber for use in a spray nozzle, wherein the spray nozzle includes a retaining body defining an inlet aperture and an outlet aperture, an orifice disk defining a peripheral edge and a spray orifice spaced inwardly relative to the peripheral edge and extending therethrough, and a retaining member, wherein the orifice disk is received within the retaining body with the spray orifice aligned with and adjacent to the outlet aperture of the retaining body, the swirl disk is received within the retaining body upstream of and contiguous to the orifice disk with the swirl chamber aligned and in fluid communication with the spray orifice of the orifice disk, at least one fluid passageway is formed between the inlet aperture of the retaining body and the flow inlet to the swirl chamber, and the retaining member is received within the retaining body in engagement with an opposite side of the swirl disk relative to the orifice disk, and secures the orifice disk and swirl disk within the retaining body, wherein the swirl disk comprises:

a sheet material substrate defining a thickness within the range of about 0.003 inch to about 0.03 inches, an etched peripheral portion defining a peripheral edge of the swirl disk, an etched first region spaced inwardly relative to the peripheral edge and forming a first aperture extending through the first region and defining a swirl chamber of the swirl disk, and an etched second region of the sheet material substrate extending between the swirl chamber and peripheral edge and defining a second aperture extending through the second region and forming a flow inlet to the swirl chamber of the swirl disk.

69. (New) A swirl disk as defined in claim 68, in combination with an orifice disk formed of a sheet material substrate defining a thickness within the range of about 0.005 inch to about 0.03 inch, an etched peripheral portion defining a peripheral edge of the orifice disk, and an etched

first region of the sheet material substrate spaced inwardly relative to the peripheral edge and defining a first aperture extending through the first region and forming a spray orifice of the orifice disk.

70. (New) A swirl disk as defined in claim 68, wherein the swirl disk defines a throat between an upstream end of the swirl inlet and the swirl chamber, a start radius within the swirl chamber, and a throat ratio defined by the ratio of the throat to the start radius and within the range of about 3:5 to about 11:10.

71. (New) A swirl disk as defined in claim 68, wherein the swirl disk further defines a first substantially planar surface on one side of the swirl disk, and a second substantially planar surface on an opposite side of the swirl disk.

72. (New) A swirl disk as defined in claim 71, wherein the first and second surfaces are substantially symmetrical about a plane approximately perpendicular to an axis of the swirl disk.

73. (New) A swirl disk as defined in claim 72, wherein the first and second surfaces of the swirl disk are substantially identical.

74. (New) A spray nozzle comprising:

first means for generating a swirling flow of fluid formed of a sheet material substrate defining a thickness within the range of about 0.003 inch to about 0.03 inch, an etched peripheral edge, an etched first region spaced inwardly relative to the peripheral edge and forming a first aperture extending through the first region and defining second means for swirling fluid within the first means, and an etched second region extending between the second means and the peripheral edge and defining a second aperture extending through the second region and forming third means for introducing a flow of fluid into the second means;

fourth means for emitting a spray of fluid exiting the first means and formed of a sheet material substrate defining a thickness within the range of about 0.005 inch to about 0.03 inch, an etched peripheral portion defining a peripheral edge, and an etched first region spaced

inwardly relative to the peripheral edge and defining a first aperture extending through the first region and forming a spray orifice in fluid communication with the second means for receiving the swirling fluid and emitting a spray of such fluid therethrough;

fifth means for retaining the first and fourth means and defining an inlet aperture in fluid communication with the first means for introducing fluid into the first means and an outlet aperture in fluid communication with the fourth means for emitting the spray of fluid therethrough; and

sixth means receivable within the fifth means for securing the first means and fourth means within the fifth means.

75. (New) A spray nozzle as defined in claim 74, wherein the fourth means is received within the fifth means with the spray orifice aligned with and adjacent to the outlet aperture of the fifth means, the first means is received within the fifth means upstream of and contiguous to the fourth means with the second means aligned and in fluid communication with the spray orifice of the fourth means, and the sixth means is in engagement with an opposite side of the first means relative to the fourth means.

76. (New) A spray nozzle as defined in claim 74, wherein the fourth means emits the fluid from the spray orifice in a spray of droplets, and at least about 90% of the emitted spray is composed of droplets having diameters of less than about 62.8 microns at a fluid pressure in the range of about 1000 psi to about 3000 psi.

77. (New) A spray nozzle as defined in claim 76, wherein the spray of droplets defines a Sauter Mean Diameter on the order of about 20 microns.

78. (New) A spray nozzle as defined in claim 75, wherein the first means is a swirl disk, the second means is a swirl chamber of the swirl disk, the third means is an inlet to the swirl chamber, the fourth means is an orifice plate, the fifth means is a nozzle body, and the sixth means is a retaining plug.